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Urine Mutagenicity as an Indicator of Exposure to Dietary Mutagens Formed During Cooking of Foods

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Studies were undertaken with individuals fed fried bacon meals to determine whether fruit or vegetables, ingested along with bacon, modified uptake and subsequent excretion of bacon mutagen(s). Urinary mutagenic activity was significant in those who had consumed bacon or mixed bacon/vegetable or bacon/fruit meals within the previous 2 to 3 hr period. Although urine activity varied by a factor of 4 among 15 subjects who consumed different meals, there was no evidence from this investigation that fruit or vegetables contributed to the inherent variability in total urinary mutagenic activity. However, some differences in excretion kinetics may be attributable to vegetable or fruit supplements in mixed meals.

Introduction

Urinary excretion is one of the mechanisms the body has available to it for eradicating xenobiotics. Whether or not foreign molecules harm the body depends on their pharmacological activity, which in turn depends on tissue distribution, metabolic pathways in specific tissues, rates of metabolism, and on the balance between intake and elimination from the body.

Notwithstanding the problem of defining precise kinetics of absorption, distribution, etc., urinary excretion has been widely used in toxicology as an exposure barometer for potentially hazardous chemicals encountered in the workplace and for medicinal and other drugs (*1,2*).

As well as toxins, mutagenic substances may be detected in urine. Durston and Ames (*3*) demonstrated the mutagenicity of a urinary metabolite excreted as a glucuronide conjugate in urine of rats administered the carcinogen, 2-acetylaminofluorene. Benzidine, *o*-toluidine, *o*-tolidine, and aniline or their mutagenic metabolites were shown to occur in the urine of rats fed with these aromatic amines (*4*). Mice administered the drug, metronidazole, excreted a mutagenic derivative, also detected in human urine (*5*). Furthermore, occupational exposure of humans to chemotherapeutic agents (*6*), anesthetic gases (*7*), epichlorhydrin (*8*), and some industrial chemicals (*9,10*) has apparently contributed to excess mutagenic activity detectable in urine. Thus, measurement of urinary activity has been proposed as a means of monitoring absorption of mutagens (*11,12*).

The search for mutagenic excretion products, which might be related to human cancer, has inevitably led to studies of "lifestyle factors" such as cigarette smoking (*13*), hairdye use (*14*), and coffee consumption (*15*). We previously reported detecting urine mutagenicity following fried pork or bacon meals (*16*). Since then Sousa, Nath, and Ong (*17*) have found a similar effect following beef meals. Both studies emphasize the absorption, distribution, and excretion of biologically detectable mutagenic substances. This finding is significant in view of the fact that nutritional components are considered to play an important role in induction of a number of human cancers (*18*).

In the present paper we examine the effect of other dietary constituents on urine mutagen excretion. Since vitamins, minerals, peroxidases, chlorophyll, etc. can inactivate or inhibit activation of pyrolysis mutagens (*19*), it is possible that similar components of vegetables and fruit, eaten along with fried meat, may directly

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also explain why there is no correlation between the amount of bacon eaten and the total urinary mutagenic activity/person/8 hr. A similar lack of correlation has been reported between the number of cigarettes smoked and mutagen levels in smokers' urines (*25*).

From this study, urine activity can be used as an indicator of exposure, but not as a dosimeter of the extent of exposure, to dietary mutagens. Thus, urinary excretion may be used to investigate inhibitory or protective factors in the diet, provided individual variation is taken into account. There is no evidence here that overall urinary clearance of bacon mutagen(s) was modified by fruit or vegetables, eaten with bacon, despite the evidence of inactivation and adsorption of pyrolysis mutagens by vegetable constituents (*20,26*).

This and similar studies point to the need to take into account individual variability, the contribution of dietary mutagens and of inhibitors of mutagenesis as potential confounding factors in using urine assays for monitoring environmental or occupational exposures.

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